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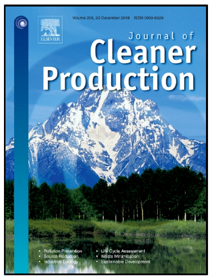

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Analysis of Some Factors Driving Ecological Sustainability in Construction Firms

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Analysis of Some Factors Driving Ecological Sustainability in Construction Firms

ABSTRACT

Construction management scholars, institutional investors, and construction practitioners are strongly emphasizing firms' needs to respond adequately to the harmful effects of construction on human societies and the environment. This study contributes to the ongoing discussion on the environmental dimension of the triple bottom line of sustainability within the construction industry by considering regulatory framework and a set of organizational capabilities (organizational culture, flexible design, quality orientation, product diversity, and customer loyalty) that have been highlighted to aid firms' achievement of ecological sustainability. Using survey data of Malaysian large construction firms, structural equation modeling was used to confirm the mediating role of organizational capabilities in the regulatory framework and ecological sustainability relationship. The findings of this study established how proactive firm core competencies can strengthen construction businesses in developing nations to discover new avenues of performing environmentally sound construction businesses. It also demonstrated how a favourable regulation targeted at the unique configuration of large construction firms in Malaysian context could contribute to their environmental sustainability performance. The limitations and future research directions are also discussed.

Keywords: Ecological sustainability; organizational capabilities; regulatory frameworks; construction firms; construction management.

INTRODUCTION

Sustainability in construction is a composite agenda which, in practice, is broken down into several inter-related keys with specific goals. While the sustainability goals are embedded in the triple bottom line of social justice, economic prosperity and ecological protection, the achievement of better sustainability outcomes in construction rest on reducing the ecological impacts of construction processes (Wong & Zhou, 2015). Therefore, this study's main focus is on ecological sustainability in construction, considering the construction sector's immense impact on the natural environment depletion, and its contribution to climate change and environmental pollution, such as air, water, and soil (Huisingh, et al., 2015). Construction activities generate excessive solid waste, consume extensive land area, accentuate several health hazards and global climate change (Kucukvar & Tatari, 2013). In the United States, for example, almost 80 per cent of all resources are consumed by construction activities, including renovation and retrofitted infrastructures and buildings (Graedel & Allenby, 2010). Thus, ecological sustainability, if well implemented, could be a silver bullet for the harmful effects of construction on human societies and the environment. In its basic principles, ecological sustainability in construction deals with the analysis of construction industry's impacts on the immediate environment from "cradle to grave" viewpoint, where issues of land utilization, material selection, energy conservation, water efficiency, waste minimization, pollution control, biodiversity and ecology among others are addressed (Abidin, 2009). Therefore, construction firms, institutional investors, and other construction practitioners must be proactive in preventing environmental impacts of construction, and at the same time, resourceful in managing their respective construction portfolios (Medineckiene, Turskis & Zavadskas, 2010).

Being proactive in delivering ecological sustainability is tasking. Construction firms, just like firms in other industries, operate within a highly competitive market. Apart from the fierce competition, a multi-stakeholders interests such as clients' specification and legislative environmental pressure are driving construction firms towards environmental responsibility (Agan, Acar & Borodin, 2013; Bamgbade, et al., 2018; Salimon et al., 2017). Achieving clients' satisfaction, therefore, requires unique capabilities which are not only valuable but also imitable, and which are not easily substituted, as these will determine their competitive ability within the industry (Gudienė, Banaitis, & Banaitienė, 2013). Several studies have concentrated on various mechanisms like firms' innovative technologies (Shari & Soebarto, 2014), organizational culture (Bamgbade, Kamaruddeen & Nawi, 2015), legislation and governmental policies (Liu, 2006) in addressing ecological sustainability. Despite the fact that there are many organizational mechanisms for improving construction firms' ecological sustainability, the effect of firm capabilities and regulatory frameworks on ecological sustainability has not been thoroughly considered in the previous studies. This study aims to fill this research gap by addressing the following questions: what are the organizational capabilities dimensions that are relevant in improving ecological sustainability in construction firms? How do these types of organizational capabilities influence ecological sustainability in construction firms? And, how do regulatory frameworks intervene in improving ecological sustainability?

Based on organizational capability theory, this study upholds the capabilities that are important for ecological sustainability in construction firms. The organizational capabilities, which include organizational culture, flexible design, quality orientation, product diversity, and customer loyalty, are given consideration because these competencies will allow firms to favourably compete in a broader market spectrum, especially in large-scale markets (Wethyavivorn, Charoenngam & Teerajetgul, 2009). Using a questionnaire survey, a dataset of 172 ecological sustainability, organizational capabilities and regulatory framework data was collected from the Malaysian large construction firms. It should also be noted that Malaysian construction firms' grades range from Grade 1 to 7 (G1 to G7), with the G1 representing the smallest grade, and G7 at the peak of the categorization. Each category has a tendering capacity and financial limits that define the value of projects that can be undertaken except for the highest grade (the G7 construction firms). This study focused on the highest grade of construction firms based on the findings from previous studies which indicated a significant relationship between construction firms' sizes and environmental sustainability performance (Akadiri & Fadiya, 2013; Du, Zheng, Xie & Mahalingam, 2014). In their study, Waris, Liew, Khamidi, and Idrus, (2014) also submitted that large Malaysia construction firms are more conversant with sustainable construction phenomenon for onsite construction activities.

The study not only theoretically develops the organizational capabilities and regulatory frameworks for ecological sustainability but also empirically examines the relationships between five types of organizational capabilities and ecological sustainability in construction organizations. These organizational capabilities are considered to be first order constructs to allow for a parsimonious theoretical relationship and a reduction in model complexity. The rest of this study is structured as follows: the next section addresses the theoretical considerations that lead to the development of this study's hypotheses. This is followed by the research hypotheses based on theoretical and empirical studies. Questionnaire design, response rate, measures, validity and reliability, and hypotheses testing are presented. The results are then presented in the section that follows while some managerial implications are explained in the last section.

Insert Figure 1.

Theoretical Considerations and Hypotheses

The theory of organizational capabilities was developed essentially as an extension of the Resource-Based View (RBV) theory. In the original RBV perception, organizations are made up of heterogeneous resources upon which their performances, and the ability of organizations' management in combining the resources depend. Barney (1991) argues that these resources and their distinctive capabilities enable organizations to gain competitive advantage and exploit market opportunities which contribute to their performance. However, organizational scholars have argued that combining resources with other complementary firm components generate capabilities that firms need to attain a competitive edge (Wang, Mao, & Archer, 2012). Thus, organizational capacity entails firms' ability to leverage its combined resources to achieve the desired result. In its typology, organizational capabilities can be either a combination of dynamic capabilities or functional capabilities (Grant, 1991; Teece et al. 1997). According to Teece et al. (1997), firms' capability to "integrate, build and reconfigure internal and external competencies to address rapidly changing environments" (p. 516) affords them the opportunity of dynamic capabilities – an orientation that allows firms to survive in a turbulent and unpredictable business environment. In recent time, organizational scholars have advanced arguments that these forms of capabilities are very important requirements for modern firms to maintain stability in the increasingly changing environment (Santos & Eisenhardt 2009; Wang, 2016). Functional capabilities, on the other hand, are informed by a firm's ability to perform the day-to-day operations of its functional departments to create values (Grant, 1991). Davies and Brady (2016) however suggested that by developing the functional capabilities in the existing technologies and markets, firms can easily attain competitive edge and success more rapidly when their competitors are struggling.

Hypotheses

Organizational Capabilities (OC), Regulatory Frameworks (RF) and Ecological Sustainability (ES)

Earlier discussion on firms' innovative capabilities to ease the tradeoff between economic gains and environmental sustainability concentrated on the "Porter hypothesis" (Porter 1991; Porter & van der Linde 1995). It stated that a well-structured environmental regulation does not necessarily impose an additional burden on firms as a result of their core capabilities like technological innovation and diffusion (Darnall et al. 2008). Ecological sustainability requires construction firms to uphold certain strategic competencies in their operations in order to deliver environmentally sustainable business. Lopez-Cabrales, Valle and Herrero (2006), for example, argued that firms with flexible design competencies enjoy greater opportunities towards green construction and better returns in the market. Recent studies have also demonstrated that firms' ability to accurately understand the business environment improves their chances of flexible adaptations at the operational level. Besides, by incorporating other external stakeholders, they are better leveraged in achieving users' satisfaction in their pursuit of sustainability strategies (Gelhard & Von Delft, 2016).

In the same manner, several studies have identified the conditions necessitating the adoption of ecological sustainability in firms (Griffiths & Petrick, 2001). However, majority of these scholars (e.g., Darnall, *et al*., 2010; Sharma & Henriques, 2005) argued that smaller construction business entities are less responsive to environmental protection policies, unless they are incapable of dismissing institutional frameworks regulating their activities, whereas larger firms are better positioned to modify their outputs and reduce ecological impacts. Importantly, responsible environmental practices in firms have been noted to improve operational processes and reduce exposure to reputational damage, thus ultimately leading to enhanced competitive advantage (Reuter et al., 2010; McWilliams & Siegel 2001). Hence we posit that:

H1: OC is positively associated with the ecological sustainability of large construction firms.
H2: RF is positively associated with the ecological sustainability of large construction firms.

Regulatory Frameworks (RF) and Organizational Capabilities (OC)

In the contemporary world, sustainable business performance remains one of the central themes of many policy agendas, as well as an important discussion among the policymakers in the current knowledge-based economy (Doh & Kim, 2014). Over the years, government institutions across the globe have placed emphasis on local and regional dynamics affecting organizational growth, especially when the large firms are important drivers of sustainable economic growth (Baumann-Pauly et al. 2013). In the Schumpeter's analysis of the mainstream economy, large firms that are operating in competitive markets are the prime movers of economic progress. This justification is used to support the industrial policies for large firms, as economic saviours and national champions, to subsidize them and to relax competition laws (Noori et al. 2016). Hence, regulatory environment aimed at strengthening their capabilities in terms of strategic flexibility, customer integration, and value chain flexibility could place them in a better position to counter the static culture within the industry, and design sustainably and avoid toxic by-products (Alwan, Jones, & Holgate, 2017). Therefore, a conducive regulatory environment is a necessary precondition for large firms' organizational performance. With strong regulatory support, organizational capabilities could be improved for a better delivery of environmental sustainability. Hence, it is hypothesized that:

H3: RF is positively associated with OC of large construction firms.

Mediating Effects of Regulatory Frameworks

The preceding discussion on the relationship between the RF, OC and ecological sustainability suggests that regulatory framework influences organizational capabilities which in turn have an impact on firm ecological sustainability compliance. The organizational capabilities theory of the firm (Grant, 1991) suggests that directing sustainability regulatory measures to favour firms in strategic resource management should improve their ecological sustainability performance. Since favourable regulatory environment allows firms to address several ecological sustainability practices, it is argued that within the context of large firms, a favourable environmental regulatory framework is a critical precursor of robust organizational capabilities that consequently lead to a superior ecological sustainability performance. The competitive edge recorded by making use of firms' core competencies in business operations have been notably triggered by the proactive environmental regulations aimed at addressing the potential negative impacts of construction firms on the immediate environment (Bos-Brouwers, 2010). Regulations provide the mechanism for firms to better exploit their capabilities to improve their ecological sustainability performance. Hence, we argue that:

H4: OC mediates the effects of RF on the ecological sustainability of large construction firms.

METHOD

Questionnaire Development and Sampling

The questionnaire for this study was adapted from previous studies. The instrument consisted of 3 parts: (1) ecological sustainability, (2) organizational capability, and (3) regulatory framework. However, in order to ensure that the adapted indicators from previous studies are relevant to the domain of each construct, a pre-test involving four experts who are familiar with the constructs of this study was conducted. These experts were asked to complete the questionnaire and also indicate if there is any ambiguity in the dictions of the questions. During this period, a follow-up interview was also conducted with the construction practitioners where suggestions were sought to improve the questionnaire. The questionnaire was further painstakingly reworded and refined by the researchers to incorporate the inputs and suggestions of the experts into the final draft of the instrument. A pilot study was also conducted to pre-test the final instrument. Forty-five (45) representatives of the construction firms who are part of the target group participated in the pre-testing. The feedback from the pilot study was used to further change the layout of the questionnaire, improve clarity and to determine the internal consistency of the constructs.

The population of registered and active large construction firms (building construction and civil engineering) in Peninsular Malaysia was obtained from the Construction Industry Development Board (CIDB) website in 2014, and the population stood at 4,520. This study aims at using a relatively larger sample size in order to achieve representativeness of the study population. Accordingly, Krejcie and Morgan's (1970) generalized sample size parameters which give a sample size of 354 is adopted in this study.

Response Rate

This study focuses on ecological sustainability among Malaysian large construction firms. Consequently, data was collected from large construction firms within building construction (B) and civil engineering (CE) categories that are located within the eleven states of Peninsular Malaysia. The copies of questionnaire were partly administered by hand while others were sent by post to the construction firms, where one representative (an executive director, a project manager, a marketing manager, an engineer, a quantity surveyor, a contract manager, a sales manager, or an account manager) in each of the construction firms, who have acquired satisfactory professional experience is deemed to be able to explain the relationships in this study.

In line with Krejcie and Morgan's (1970) sample size determination, the minimum sample size for this study is 354 for a population of 4520 construction firms. However, studies within the construction industry are associated with a low rate of response. This study takes care of this peculiarity by doubling the sample size, as suggested by Hair, et al. (2008). Hence, a total of 708 copies of the questionnaire were administered. A covering letter which explained the purpose of the study, and which assured respondents of their anonymity and confidentiality was attached to the survey instrument. After a period of twenty weeks of data collection, 189 firms were able to respond to the survey.

Insert Table 1.

However, only 172 copies of the questionnaire were retained for analysis, owing to invalid and incomplete responses specifically responsible for the exclusion of 9 responses. Another 8 cases were removed after the assessment of multivariate outlier. This gives a 24 % overall response rate. The questionnaire administration and the decision is presented in Table 1. A detail of the sample is given in in Table 2, where the majority of firms (63.3%) have been operating for more than 10 years. Majority of the construction firms (69.7%) that participated in the survey have less than 100 employees. Using a multiple response option, the majority of the sampled firms (31.7%) specializes in residential building construction. Construction firms from infrastructure specialty (26.3%) constitute about half of the total sample.

Insert Table 2.

Measures

Organizational capabilities was measured in this study by 25 items adapted from Lopez-Cabralez et al. (2006). Responses to statements (like workers can identify and articulate the firm's shared values) are expressed in a 5-point Likert scale, with 5 reflecting high organizational capability and 1 representing an absence of capability. These 24 items were used to measure five specific constructs, which are firm culture (six items), customer loyalty (five items), flexible design (five items), product diversity (four items), and quality orientation (five items). Organizational capabilities is measured as a higher order construct. This measurement approach is consistent with previous studies like Amabile, et al. 1996; Dess, et al. 1995; Lopez-Cabralez et al., 2006.

Regulatory frameworks was measured by 5 items composed of statements such as "the need to meet regulation is increasing client's demand for sustainable construction" for which respondents were asked to indicate their level of agreement or disagreement using a 5-point Likert scale where 1 = not at all…5 = completely true. These items, which were adapted from Akadiri and Fadiya (2013), were validated by academic and industry experts prior to the actual survey.

Ecological sustainability was measured using 8 items. Responding firms were asked to indicate whether their firms consider the core environmental issues in construction project execution on a 5-point scale (1=not at all; 2=slightly true; 3=moderately true; 4=mostly true; 5=completely true).

Control Variables. Two control variables: firm age (i.e., the number of years in construction business) and firm size (in terms of the number of employees) are included in this study to test the hypotheses. It is expected that larger and old firms will be able to develop more capabilities to adopt ecological sustainability (Bos-Brouwers, 2010; Roxas, et al. 2016).

Data Screening and Outlier Analyses

The dataset was screened for univariate and multivariate outliers (Tabachnick & Fidell, 2013). Using standardized values with a cut-off of ±3.29 ($p < 0.001$) as the criteria to detect univariate outliers, no value was found as a potential univariate outlier. In order to further avoid the effects of outliers on the statistical analyses, multivariate outliers identification was also carried out by considering all variables in the model with the aid of Mahalanobis distance. According to Tabachnick & Fidell, (2007), Mahalanobis distance (D^2) is the distance of "a case from the centroid of the remaining cases where the centroid is the point created at the intersection of the means of all the variables" (p. 74). A case is marked as an outlier if the probability associated with its Mahalanobis distance is less than 0.001. Following this procedure, eight multivariate outliers were subsequently removed from the dataset in order to avoid their adverse effects on the data analysis accuracy. After the removal of these eight outliers, this study's final dataset became 172.

Owing to the fact that this study utilized a self-reporting survey, Podsakoff and Organ's (1986) Harman's single factor test was carried out to further examine common method variance. This test requires all variables in the study to be entered into exploratory factor analysis (EFA) with the aid of unrotated principal components factor analysis. This is done to determine the particular number of factors that are required to account for the variance in all the variables. The results indicate that common method variance is not of great concern in this study, and it is not likely to inflate the relationships among the variables measured in this study.

RESULTS

Demographics

The sample from 172 respondents has a relatively uneven split between male (67.5%) and female (31.1%) respondents. The major group of respondents includes other senior staffs (18.3%), executive directors (17.4%), engineers (16.7%), quantity surveyors (13.9%), contract managers (8.9%), construction managers (7.2%), and marketing managers (2.8%). Overall, 46.5% of the participants have between 1 and 5 years of experience within construction organizations.

Model Estimation

Structural equation modelling (SEM) was used to test this study's hypotheses, using the SmartPLS 2. The PLS approach is considered in this study because it is suitable for small sample size, small items and limited latent variables which are not large enough for covariance-based SEM. The theoretical model includes three reflective constructs, where one (organizational capabilities) is a multi-dimensional construct. Following the techniques outlined by Hair et al., (2011) for the evaluation of PLS-SEM measurement models, four types of tests were carried out to validate these reflective constructs. These include indicator reliability, the internal consistency of reliability, convergent validity and discriminant validity. For these reflective constructs, loadings of the respective indicators on their latent constructs and their composite reliability coefficients (CRC) are shown in Table 3. Organizational capabilities is considered a second-order construct in this study.

The values of the item loadings range from 0.64 to 0.90, which are above the recommended threshold of 0.40, indicating that individual item reliability has been confirmed. All the values recorded for the composite reliability coefficients (CRC) were above the minimum threshold of 0.70, suggesting the homogeneity, reliability and internal consistency of each of this study's latent constructs (Bagozzi, Yi, & Phillips 1991). The convergent validity is tested by the average variance extracted (AVE) using the recommended threshold of 0.50. All the AVE values range from 0.60 to 0.72, suggesting that convergent validity is acceptable. Equally, the items' cross-loadings in other latent constructs are considerably lower than the pre-determined loadings, which is an indication of discriminant validity.

Insert Table 3.

In order to evaluate the discriminant validity in this study, we calculated the square root of AVE for each latent construct and checked whether they (the squared AVE) are higher than the correlation of other constructs. The bold, italicized figures along the diagonals in Table 4 indicated that the squared AVEs exceeded the off-diagonal correlations between the latent constructs. Therefore, the discriminant validity in this study has been confirmed.

Insert Table 4.

Also, Table 4 shows the means, standard deviation (SD), and correlations among the seven latent constructs that will be used in the subsequent inner model analysis. The italicized figures in bold are the squared AVEs of each of the latent constructs which are higher than the off-diagonal coefficients in the corresponding rows and columns (Bagozzi, Yi, & Phillips 1991). Generally, the results generated from the measurement model-data fit indicated that this study's constructs have adequate levels of construct validity, the internal consistency of reliability, as well as convergent and discriminant validities.

Structural Model Analysis

The second step in the structural equation modelling requires the testing of the hypothesized paths in the structural model. Figure 2, as well as Table 7, reveals that 56.1 per cent of the variation in ES is explained by the constructs of organizational capabilities and regulatory framework. Ecological sustainability was significantly influenced by organizational capabilities (β=0.581, p<0.001), and regulatory framework (β = 0.245, p<0.001) Moreover, organizational capabilities have been reported to have the strongest influence on ecological sustainability. The result also implies that regulatory framework was a significant determinant of organizational capabilities (R^2 = 32.7 per cent), since regulatory framework (β = 0.572, p<0.001) significantly and positively impacted organizational capabilities. Hence, H3 was supported.

Insert Figure 2.

Insert Table 5.

Mediating effect. The value of variance accounted for (VAF) was determined to understand the role of organizational capabilities as a mediator. A value of VAF that is greater than 80 per cent indicates full mediation while a value lower than 20 per cent signifies no mediation effects. Also, a VAF that is between 20 and 80 per cent is an indication of partial mediation (Hair et al., 2014). Table 6 demonstrates that the mediating effect is 51.3 per cent which implies that the VAF falls within the range of 20 and 80 per cent and thus, there is a partial mediation (Hair et al., 2013).

Insert Table 6.

Predictive Relevance and Effect Size.

In Table 7, the variance explained (R^2) and predictive relevance of the endogenous latent constructs are reported. According to Cohen (2013), the Stone-Geisser's Q^2 values of 0.02, 0.15, and 0.35 signify small, medium, and large predictive relevance respectively. ES and OC were found to have adequate predictive relevance, as the reported Q^2 values for the two endogenous latent constructs (ES and OC) are 0.36 and 0.16 respectively. Therefore, this research model has a predictive power to explain the construction firm's ecological sustainability performance. Also, in the model, ES is seen to be positively and significantly correlated with the age of firms, which suggests that ES increases relative to the longevity of firms.

Insert Table 7.

Also, the effect size, which reflects of the statistical power of the research model, is determined. There are two types of effect sizes. The effect size (f^2) assesses the change in the R^2 value when an exogenous construct is removed from the model. It is an evaluation that explains the impact of the omitted construct on the endogenous constructs (Hair et al., 2013). Similarly, the effect size (q^2) is used to measure the level of exogenous construct's contribution to the endogenous construct's Q^2 value. The effect sizes of this study's endogenous constructs, which are reported in Table 8, are calculated using the blindfolding procedure. As suggested by Cohen (1988), f^2 and q^2 values of either 0.02, 0.15, or 0.35 is an indication that an exogenous construct has a small, medium, or large effect size for a particular endogenous construct.

Insert Table 8.

Discussion

The main objectives of this study were to assess the effects of government regulatory framework (RF) on organizational capabilities (OC) and the consequent effects on the ecological sustainability (ES) of large construction firms in the context of Malaysian construction industry. The study was able to find a strong empirical evidence for the hypothesized positive effects of RF on the construction firms' ES performance. Both the regulatory frameworks and capabilities have also shown to have contributed positively to the ecological sustainability performance of the large contractors in the sample. The findings of the current study have established that while environmental regulations remain a strong driver of ES among the large construction firms, the intervention of organizational capabilities is needed for its efficient delivery. First, the study offers empirical evidence that, despite their ability to engage in environmentally sustainable construction practices, large firms in most developing countries are compelled to heed to environmental sustainability considerations (Sezer, 2015). The adoption of ecological sustainability in large construction firms has always been reported with bureaucracy unlike in small firms where it is less systematic and mostly informal (Martín-Tapia et al. 2010; Roxas et al. 2016). The findings of the study suggest that ecological policies needed to be strengthened to help large construction firms overcome the intrinsic limitations often associated with them in furthering their OC.

Second, this finding provides a more nuanced understanding of how government regulatory pressure may offer better explanations on why some large construction businesses are inclined to perform better in their strategic organizational capabilities (Yam et al. 2011). Previous studies (e.g., Aragon-Correa & Sharma 2003) have indicated how proactive firms continuously improve their capabilities by investing in programs that go beyond ordinary regulatory compliance due to business environment uncertainties created by stakeholders' pressures, and increased regulatory hostilities that most likely lead to tougher regulations and expectations for more environmental performance. While many large construction firms' overall environmental sustainability performance may initially be driven by regulations (Dangelico & Pujari 2010), those firms that have successfully developed a strong strategic capabilities toward sustainability performance are always characterized by constant learning and innovation in the midst of high competition and uncertainty (Adeleke et al., 2017; Kuckertz & Wagner 2010).

The positive effects of OC on the ecological sustainability of the sampled firms offer novel empirical evidence that large construction firms are better positioned to reap positive outcomes in their implementation of sustainability-related measures such as pollution reduction and control by improving their strategic organizational capabilities. The findings offer empirical support to the basic tenet of organizational capabilities theory (Grant, 1991) that a firm can be environmentally sustainable while also attaining a competitive edge using its distinctive capabilities. While the theory of organizational capabilities underscores strategic capabilities such as meeting the needs of organizational stakeholders and simultaneously reducing ecological constraints as key to business sustainability, the findings of the study offer a more detailed explanation on how large construction firms may sustain these capabilities with the aid of friendly regulatory environment.

Overall, the findings of the study highlight some important points. First, it suggests that organizational capabilities underpinned by quality orientation, product diversity, and customer satisfaction play a key role in overcoming several organizational constraints in the development of environmental sustainability. A strong and proactive firm core competencies can further strengthen construction businesses in such a developing country like Malaysia to discover new avenues of performing environmentally sound construction businesses despite some unfavourable indigenous business environment that is peculiar to emerging economies. Finally, a favourable regulation that is targeted at the unique configuration of large construction firms in the Malaysian context is likely to contribute positively to their environmental sustainability performance. While our study was able to demonstrate that large construction firms in a developing country like Malaysia are better leveraged to perform better environmental sustainability if they develop their core organizational competencies, it is acknowledged that the effects of regulations and organizational capabilities on ecological sustainability may differ for construction SMEs. Surprisingly, other construction SMEs in some developed nations have been noted to be more actively engaged in environmental sustainability (Roxas et al. 2016), possibly due to their inability to resist external pressures.

Conclusion, Limitations, and Directions for Future Research

This study also has a number of limitations that point to issues for future investigation. First, the focus on large construction firms from Peninsular Malaysia alone implies that the findings may not necessarily be generalizable to other large construction firms in the Eastern Malaysia or overseas, since the differences in regulatory environments at the sub-national and transnational levels can lead to variations in firms' environmental sustainability performance. Thus, future studies may need to investigate the influence of regulatory environments on organizational capabilities and ecological sustainability across diverse settings, locally and internationally. The environmental regulations and construction compliance standards faced by firms vary considerably at the sub-regional and level. For this reason, it is important to extend this study to other ASEAN countries to get additional information about the design of ecological sustainability policies and programmes. Second, the items for measuring ecological sustainability did not consider whether the sampled firms undertook sustainability practices for the sake of regulatory compliance or to demonstrate their position toward sustainability adoption. Therefore, it is important for future studies to re-examine other enablers, drivers and impetuses of ecological sustainability. Third, the conceptualization of the control variable, firm age and size as measured by the number of years in the construction business and the number of employees, may not adequately distinguish between extremely large and small construction firms. Subsequent studies should differentiate these firms based on other sub-categories within the large firm size range in order to gain wider insights into how firm size impacts sustainability performance. Fourth, future research design could also consider a longitudinal technique to better comprehend the changes in firm ecological sustainability associated with capabilities and regulations over time because a deeper understanding of how construction firms perform in ecological issues over time should be valuable for policymaking.

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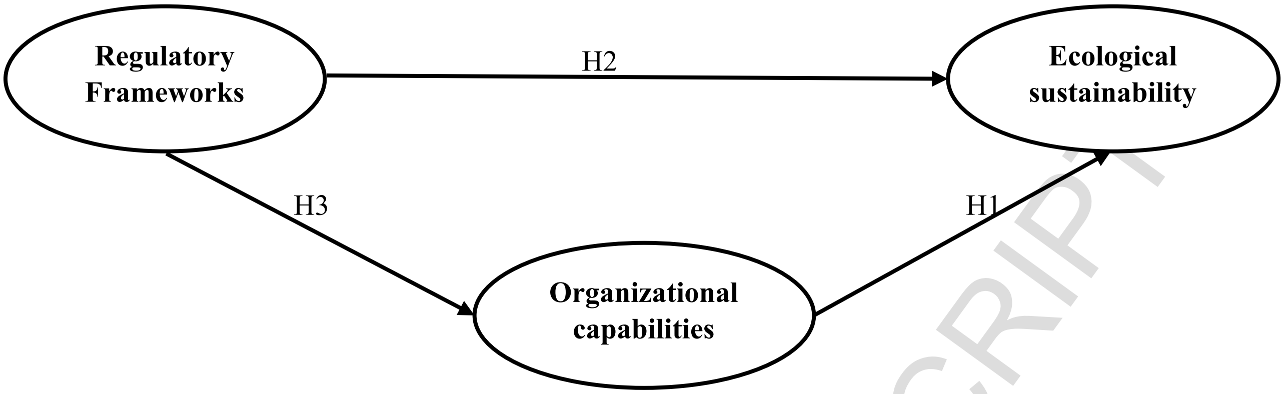

Figure 1. *Effects of Organizational Capabilities and Regulatory Framework on Ecological Sustainability*

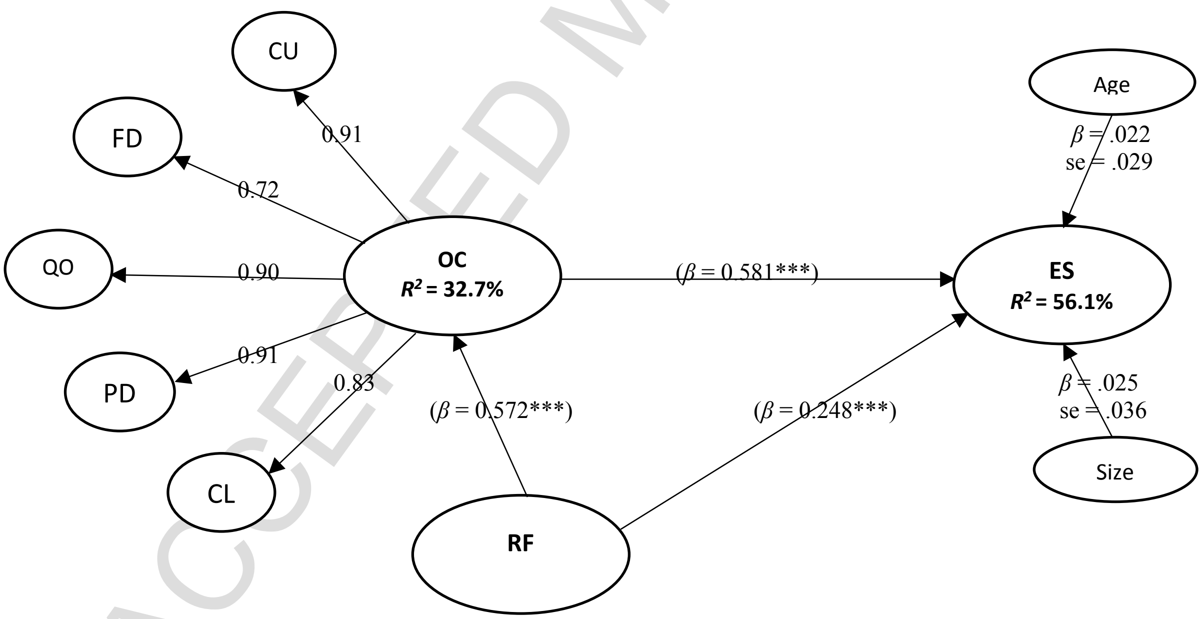

Figure 2. *The PLS-SEM result*

Notes: CU, culture; FD, flexible design; QO, quality orientation; PD, product diversity; CL, customer loyalty; OC, organizational capabilities; RF, regulatory framework; ES, ecological sustainability.

Highlights.

- Regulations explain why some firms perform better in their strategic capabilities
- Firms can address sustainability and be competitive using their unique capabilities
- Firm capabilities is crucial to improve environmental sustainability in large firms
- Mediating role of capabilities in regulations/sustainability relationship is key

Table 1.
Questionnaire Distribution and Decisions

Item	*f*	%
Distributed Questionnaires	708	100.00
Returned Questionnaires	189	26.50
Rejected Questionnaires	17	2.4
Retained Questionnaires	172	24.3

Table 2
Firm Characteristics

Firm Size	*f*	%
<100 employees	120	69.7
101-250	13	7.6
251-500	10	5.6
>500	29	16.1
Firm Age		
1-5 years	36	21.1
6-10 years	27	15.6
More than 10 years	109	63.3
Firm Specialization		
Residential apartment	99	31.7
Non-residential apartment	75	24.0
Social amenities	32	10.3
Infrastructure	82	26.3
Others	24	7.7
Profile of Respondents		
Executive Director	20	11.6
Project manager	30	17.4
Marketing Manager	5	2.8
Engineer	30	16.7
Quantity Surveyor	25	13.9
Contract Manager	16	8.9
Construction Manager	13	7.2
Others	33	18.3
Work Experience		
1-5 Years	80	46.5
6-10 years	42	23.3
More than 10 years	50	27.8
Gender		
Male	116	67.5
Female	56	31.1

Table 3: *Measurement Model*

Constructs	Factor Loadings	
Ecological sustainability	First order	Second order (AVE = .69, CRC = .92)
ES 1. Land utilization is an important sustainable construction factor in our projects.	0.87	
ES 2. Material selection is an important sustainable construction consideration in our projects	0.81	
ES 3. Waste minimization is an important sustainable construction consideration in our projects	0.82	
ES 4. Energy conservation is an important sustainable construction consideration in our projects	0.82	
ES 5. Water efficiency is an important sustainable construction consideration in our projects	0.85	
ES 6. Pollution control is an important sustainable construction consideration in our projects	0.86	
ES 7. Biodiversity protection is an important sustainable construction consideration in our projects	0.75	
ES 8. Heritage and amenity protection is an important sustainable construction consideration in our projects	0.64	
Organizational capabilities		AVE = .60, CRC = .88
Customer loyalty	AVE = .69, CRC = .92	.83
CL1. The key objective of our firm is customer satisfaction	0.86	
CL2. Our firm is always available to hear customers' needs or criticisms	0.81	
CL3. Our firm treats all customers fairly and impartially	0.87	
CL4. The percentage of customer retention is high compared to other businesses in the same sector	0.90	
CL5. Our warranty allows a refund/repair of a bad products	0.70	
Organizational culture	AVE = .60, CRC = .90	.91
OC1. Our managers communicate to employees the shared values of the firm	0.77	
OC2. Workers can identify and articulate the firm's shared values	0.79	
OC3. There are very few instances when workers' actions appear to violate the firm's espoused values	0.77	
OC4. The coherence between candidate's values and firm culture is examined in the selection process	0.77	
OC5. Employees' behaviours that are coherent with firm culture are rewarded	0.79	
OC6. Managers provide support to employees to reach firm's goals	0.77	
Flexible design	AVE = .68, CRC = .91	.72
FD1. Jobs are broadly designed.	0.87	
FD2. The culture is characterized by a willingness and eagerness to change	0.86	
FD3. Financial, intangible, and human resources can be easily moved	0.84	
FD4. Decision making is highly decentralized	0.86	
FD5. Unimportant functions are externalized or outsourced	0.69	
Product diversity	AVE = .64, CRC = .88	.91
PD1. Our business is located in several sections	0.80	
PD2. Our firm is able to obtain several products/services with lower cost through its synergy	0.82	
PD3. Our products/services are unique but related	0.79	
PD4. Product diversity is one of our firm's priority	0.80	
Quality orientation	AVE = .72, CRC = .93	.90
QO1. There is a strong commitment to quality at all organizational levels	0.81	
QO2. Continuous improvement is a key objective for our firm	0.85	
QO3. Our workers keep records and measures about the quality of their work	0.88	
QO4. Techniques like "brainstorming" are used to improve the quality of our outputs	0.87	
QO5. Workers critically analyze the quality of their output	0.83	
Regulatory framework		AVE = .69, CRC = .92
Reg1. Government regulations in terms of standards and incentives are responsible for effective sustainability practices	0.81	

Reg2. Our aim of meeting regulations is increasing client's demand for construction sustainability practices	0.82
Reg3. Government support for sustainability practices have impacts on our construction practices	0.88
Reg4. Regulations for sustainability can effectively address issues regarding the sustainability of construction process	0.87
Reg5. Malaysian sustainability laws are appropriate to the construction industry environment	0.76

Table 4
Descriptive Statistics and Correlations

Variables in the study	Mean	SD	CL	FC	ES	FD	PD	QO	RF
Customer loyalty (CL)	3.49	.82	***0.83***						
Firm culture (FC)	3.40	.72	0.68	***0.77***					
Ecological sustainability (ES)	3.84	.67	0.66	0.64	***0.80***				
Flexible design (FD)	4.09	.66	0.46	0.57	0.53	***0.83***			
Product diversity (PD)	3.88	.68	0.74	0.71	0.70	0.61	***0.80***		
Quality orientation (QO)	3.96	.65	0.65	0.62	0.57	0.53	0.60	***0.85***	
Regulatory framework (RF)	3.98	.69	-0.54	-0.45	-0.58	-0.52	-0.50	-0.45	***0.83***

Notes: Square roots of average variance extracted (AVEs) are shown on the diagonal.

Table 5
Structural Model Result

Paths	β	Standard error	t -Value	P-Value	Decision
OC -> ES	0.581***	0.074	7.881	0.00	Supported
RF -> ES	0.248***	0.079	3.141	0.00	Supported
RF -> OC	0.572***	0.059	9.744	0.00	Supported
		Indirect effect			
RF -> OC -> ES	0.259	0.050	5.133	0.00	Supported

Notes: ***$p< .001$

Table 6
Variance Accounted for (VAF) of the Mediator Variable for ES

IV	**MV**	**DV**	**Indirect effect**	**Total effect**	**VAF (%)**
RF	OC	ES	0.259	0.504	51.3

Notes: IV, independent variable; MV, mediating variable; DV, dependent variable; RF, regulatory framework; OC, organizational capabilities; ES, ecological sustainability. *VAF = indirect effect/total effect.*

Table 7

Predictive Relevance of the Endogenous Constructs

Endogenous constructs	R^2	Q^2
OC	0.327	0.16
ES	0.561	0.36

Table 8

Effect Size

	ES (dependent variable)		
	Path coefficients	f^2	q^2
OC	0.581	0.093	0.223
RF	0.248	0.506	0.044